Generalized Instantaneous Bethe–Salpeter Equation and Exact Quark Propagators

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Assuming all interactions to be instantaneous *and* the exact fermion propagator S to be approximately given by $\mathrm{i}S^{-1}(p) = A(\mathbf{p}^2)\,\not{p} - B(\mathbf{p}^2)$, i.e., with its scalar functions A and B depending only on $\mathbf{p}$, a three-dimensional reduction of the homogeneous Bethe–Salpeter equation retaining, in contrast to the Salpeter equation, the exact propagators (crucial for, e.g., a proper incorporation of dynamical chiral symmetry breakdown) is constructed [1]. For spherically symmetric interactions the resulting bound-state equation reduces to a set of (coupled) integral equations for the independent radial components of the bound-state amplitude [2], which may be solved by conversion into an equivalent matrix problem [3]. Adopting as light-quark propagator the solution of the quark Dyson–Schwinger equation found within a model [4] consistent with the QCD axial-vector Ward–Takahashi identity, a tentative application [5] to "pion-like" pseudoscalar ($J^{PC} = 0^{-+}$) mesons considered as quark–antiquark bound states formed by linear confining interactions of time-component Lorentz-vector Dirac structure $\gamma^0 \otimes \gamma^0$ indicates that our "exact-propagator instantaneous formalism" yields significantly smaller spacings of its bound-state mass eigenvalues than those obtained from Salpeter's equation for "reasonable" constituent light-quark masses.

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